

## **PCT**

#### **NOTIFICATION OF ELECTION**

(PCT Rule 61.2)

ROBERTSSON, Hans et al

#### From the INTERNATIONAL BUREAU

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in its capacity as elected Office

26 October 2000 (26.10.00)	
International application No. PCT/SE00/00442	Applicant's or agent's file reference 909 PCT
International filing date (day/month/year) 06 March 2000 (06.03.00)	Priority date (day/month/year) 10 March 1999 (10.03.99)
Applicant	

	The designated Office is hereby notified of its election made:
1.	The designated Office is hereby notified of its election made:
	X in the demand filed with the International Preliminary Examining Authority on:
	28 September 2000 (28.09.00)
	in a notice effecting later election filed with the International Bureau on:
2.	The election X was
	was not
	made before the expiration of 19 months from the priority date or, where Rule 32 applies, within the time limit under Rule 32.2(b).

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**Authorized officer** 

R. E. Stoffel

Telephone No.: (41-22) 338.83.38

# **PCT**

REC'D 02 APR 2001

INTERNATIONAL PRELIMINARY EXAMINATION REPORT

(PCT Article 36 and Rule 70)

Applicant's or agent's file reference	TOP SUPERING A CYCL	See Notific	eation of Transmittal of International
909 PCT	FOR FURTHER ACTION	Preliminar	y Examination Report (Form PCT/IPEA/416)
International application No.	International filing date (de	ay/month/year)	Priority date (day/month/year)
PCT/SE00/00442	06.03.2000		10.03.1999
International Patent Classification (IPC) o	r national classification and	IPC <sub>7</sub>	
F41A 33/02, F41G 1/54			
			1
Applicant	7D -+ -1		
Saab Training Systems	AB et al		
This international preliminary example:	amination report has been pr	epared by this Inte	rnational Preliminary Examining
Authority and is transmitted to the	ne applicant according to Art	icie 36.	
2. This REPORT consists of a total	of 3 sheets,	including this cove	er sheet.
This report is also accomp	anied by ANNEXES, i.e., sh	eets of the descrip	tion, claims and/or drawings which have
been amended and are the	basis for this report and/or s	heets containing re	ectifications made before this Authority
(see Rule 70.16 and Section	n 607 of the Administrative	instructions under	the r C 1 j.
These annexes consist of a total	of sheets.		
	1		
3. This report contains indications r	elating to the following item	is:	
I Basis of the report			
II Priority			
III Non-establishment	of opinion with regard to no	velty, inventive ste	p and industrial applicability
IV  Lack of unity of inv			
<u> </u>		and to povolty in	ventive step or industrial applicability;
Reasoned statement citations and explan	ations supporting such state	ment	ventive step of industrial approaching,
VI Certain documents			
VII Certain defects in the	ne international application		
		ation	
VIII Certain observation	s on the international applic	ation	
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Date of submission of the demand		Date of completion	on of this report
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28.09.2000		20.02.200	01
Name and mailing address of the IPEA/	SE	Authorized office	er
Patent- och registreringsverke			
Box 5055 S-102 42 STOCKHOLM	PATOREG-S		Wendenius / JA A
Facsimile No. 08-667 72 88		Telephone No. 0	8-782 25 00



International application No.
PCT/SE00/00442

I.	Basi	is of the report
1.	With	regard to the elements of the international application:*
	$\boxtimes$	the international application as originally filed
		the description:
		pages, as originally filed
		pages, filed with the demand pages, filed with the letter of
		the claims:  pages  , as originally filed
		as amended (together with any statement) under article 19
		, mod with the demand
	_	pages, filed with the letter of
		the drawings: , as originally filed
		pages
		pages, filed with the letter of
		the sequence listing part of the description:
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		pages, filed with the letter of
2	tha i	n regard to the language, all the elements marked above were available or furnished to this Authority in the language in which international application was filed, unless otherwise indicated under this item.  se elements were available or furnished to this Authority in the following language which is:
		the language of a translation furnished for the purposes of international search (under Rule 23.1(b)).
١		the language of publication of the international application (under Rule 48.3(b)). the language of the translation furnished for the purposes of international preliminary examination (under Rules 55.2 and/
		or 55.3).
	3. With preli	h regard to any nucleotide and/or amino acid sequence disclosed in the international application, the international iminary examination was carried out on the basis of the sequence listing:
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l		filed together with the international application in computer readable form.
l		furnished subsequently to this Authority in written form.
١		furnished subsequently to this Authority in computer readable form.
		The statement that the subsequently furnished written sequence listing does not go beyond the disclosure in the international application as filed has been furnished.  The statement that the information recorded in computer readable form is identical to the written sequence listing has been furnished.
	4.	The amendments have resulted in the cancellation of:
ì		the description, pages
		the claims, Nos.
		the drawings, sheet/fig
	5.	This report has been established as if (some of) the amendments had not been made, since they have been considered to go beyond the disclosure as filed, as indicated in the Supplemental Box (Rule 70.2 (c)).**
	in	eplacement sheets which have been furnished to the receiving Office in response to an invitation under Article 14 are referred to this report as "originally filed" and are annexed to this report since they do not contain amendments (Rules 70.16 nd 70.17).
		ny replacement sheet containing such amendments must be referred to under item I and annexed to this report.

## INTERNATIONAL PRELIMINARY EXAMINATION REPORT

International application No.
PCT/SE00/00442

v.	Reasoned statement under Article 35(2) with regard to novelty, inventive step or industrial	applicabil	ity;
-	citations and explanations supporting such statement		

1.	Statement			
	Novelty (N)	Claims Claims	1-33	YES NO
	Inventive step (IS)	Claims Claims	1-33	YES NO
	Industrial applicability (IA)	Claims Claims	1-33	YES NO

## 2. Citations and explanations (Rule 70.7)

The invention concerns a simulator and a method as stated in the preambles of claims 1 and 27 and aims to provide a simulator and a method that i. e. enables the firer to simply align the sight with the simulator axis with the aid of the means of adjustment.

According to the invention, this is achieved by arranging the simulator with a second device generating an alignment beam along an alignment axis with an fixed and known angle to the simulator beam and with a means of adjustment that collectively guides the alignment and simulator axis during the alignment with the sight while maintaining the their relative angular relationship as stated in the characterising parts of claims 1 and 27.

In the documents cited in the ISR are shown simulators and methods comprising simulators emitting beams that are used for aligning the boresight with the target.

The known simulators and methods do not comprise a simulator that also comprises a second device generating an alignment beam and adjustment means that during adjustment collectively maintain the beams in a fixed relative angular relationship as in the invention.

As the simulator and method in claims 1 and 27 are new, are considered to contain an inventive step, and also are industrially applicable, the patentability criteria are met.



# **PCT**

## INTERNATIONAL SEARCH REPORT

(PCT Article 18 and Rules 43 and 44)

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Applicant's or agent's file reference 909 PCT	FOR FURTHER ACTION		Transmittal of International Search Report  0) as well as, where applicable, item 5 below.
International application No.	International filing date	e (day month year)	(Earliest) Priority Date (day/month/year)
PCT/SE 00/00442	6 March 2000		10 March 1999
Applicant			
SAAB TRAINING SYSTEMS AB e	t al		
This international search report has applicant according to Article 18. A	been prepared by this In copy is being transmitted	ternational Searchi d to the Internation	ng Authority and is transmitted to the al Bureau.
This international search report cons	ists of a total of 3	_ sheets.	
X It is also accompanied by a	copy of each prior art of	document cited in t	his report.
1. Certain claims were found u	insearchable (See Box I)		·
2. Unity of invention is lacking	g (See Box II).		
3. The international application international search was ca	on contains disclosure of rried out on the basis of	a nucleotide and/o the sequence listing	r amino acid sequence listing and the
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6. The figure of the drawings to be	published with the absuras suggested by the appl	_	Name of the figures
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	because this figure better	r characterizes the	шуенцоп.

#### A. CLASSIFICATION OF SUBJECT MATTER

IPC7: F41A 33/02, F41G 1/54, F41G 3/32, F41G 3/26
According to International Patent Classification (IPC) or to both national classification and IPC

#### B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)

IPC7: F41A, F41G

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

SE,DK,FI,NO classes as above

Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
A	US 5060391 A (J.A. CAMERON ET AL), 29 October 1999 (29.10.99)	1-33
A	US 5001836 A (J.A. CAMERON ET AL), 26 March 1991 (26.03.91)	
	~~	
A	GB 2300904 A (PYSER-SGI LIMITED), 20 November 1996 (20.11.96)	
A	US 3792535 A (A.H. MARSHALL ET AL), 19 February 1974 (19.02.74)	
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X	Further documents are listed in the continuation of Box	. C.	X See patent family annex.
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Date	of the actual completion of the international search	Date	of mailing of the international search report
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Form PCT/ISA/210 (second sheet) (July 1992)

In Lational application No.
PCT/SE 00/00442

Category*	Citation of document, with indication, where appropriate, of the relevant	passages Relevant to claim No
Α .	WO 9530123 A1 (CUBIC DEFENSE SYSTEMS, INC.), 9 November 1995 (09.11.95)	
A	WO 9530124 A1 (CUBIC DEFENSE SYSTEMS, INC.), 9 November 1995 (09.11.95)	
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# INTERNATION SEARCH REPORT Information on patent family members

International application No.
PCT/SE 00/00442

02/12/99
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	in search repor		date		member(s)	date
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				GB	9510160 D	00/00/00
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				MO	9530124 A	09/11/95

## INTERNATION... SEARCH REPORT

Information on patent family members

International application No.

02/12/99 | PCT/SE 00/00442

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			WO	9530123 A	09/11/95

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**A1** 

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(71) Applicant (for all designated States except US): SAAB TRAIN-ING SYSTEMS AB [SE/SE]; S-561 85 Huskvarna (SE).

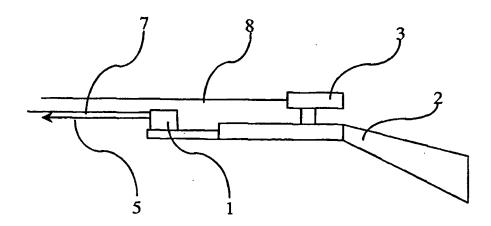
(72) Inventors; and

- (75) Inventors/Applicants (for US only): ROBERTSSON, Hans [SE/SE]; Astronomgatan 10, S-554 48 Jönköping (SE). FREDRIKSSON, Amold [SE/SE]; Vallmostigen 5, S-561 39 Huskvarna (SE).
- (74) Agent: LUNDMARK, Jan-Erik; SAAB AB, Patent Department, S-581 88 Linköping (SE).

(54) Title: FIRING SIMULATOR

#### (57) Abstract

device and method for simulation (1) of firing by means of a weapon (2). The simulator is mounted onto a weapon with a sight (3), with the simulator arranged to emit an electromagnetic simulator beam exiting along a simulator axis Furthermore, (5).simulator (1) is arranged to emit a visible alignment beam along an alignment axis (7) that has a fixed angular relationship to the aforementioned The simulator axis (5).



contains a means of adjustment to collectively control both of the aforementioned axes so that they maintain their fixed relative angular relationship during an alignment. The alignment beam may generate an alignment mark (9) which, when observed in the sight (3) of the weapon, indicates the error in alignment between the simulator axis (5) and the sight (3). This makes it possible for a firer easily to align the sighting axis to the simulator axis with the aid of the means of adjustment.

## FOR THE PURPOSES OF INFORMATION ONLY

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#### FIRING SIMULATOR

#### TECHNICAL AREA

5 The invention concerns a simulator for simulating firing. The simulator is intended for mounting onto a weapon with a sight.

#### THE PRIOR ART

During simulated firing, the simulator emits a laser beam or a beam of electromagnetic radiation that has been generated by another technique than using a laser. The radiation can be detected by one or several detectors belonging to a target system mounted on the target. The emitted radiation, for example laser radiation, has different intensities in different directions of radiation, whereby these are collectively termed the laser lobe. If the radiant intensity from the laser lobe at a particular distance from the emitter and in a particular direction exceeds a detection level at any detector on the target, a simulated effect of firing with the weapon towards the target system that lies in the said direction and at the said distance is obtained.

When a simulator is attached to a weapon, the direction of fire of the simulator must be aligned with the direction of fire of the weapon. This can be achieved by aiming the weapon with the aid of its ordinary sight towards a target that is designed to be sensitive to the simulated firing of the simulator. The simulator is fired, and one observes how the hits fall on the target in relation to the direction of firing of the weapon. If there is any deviation, the direction of firing of the simulator is adjusted by means of an adjustment device built into the simulator, until the weapon and the simulator are co-aligned.

This method is often unwieldy and takes a great deal of time, since the method is iterative. Furthermore, the target must be arranged so that it can indicate exactly where the simulator hits, in order for the adjustment to be carried out reasonably rapidly.

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Arrangement of the target thus becomes complex and expensive, which means that the number of adjustment devices per trainee in a unit must be limited during firing training using weapons by means of the use of a simulator. This means that the trainees must queue in order to carry out the adjustment, and considerable time must be allocated for preparing for the training, losing valuable training time.

Patent document WO 95/30124 describes a simulator with improved properties. The firer does not need to carry out the adjustment himself/herself, since the simulator is designed for the connection of an electromechanical adjustment head that can align the firing direction of the simulator to the sight of the weapon. This method can give a considerable increase in speed of the process.

Patent document WO 95/30123 describes a device that is used according to the aforementioned patent document in order to carry out the alignment automatically. It is clear that this device also is complex and expensive, and even if the alignment procedure is more rapid, a problem arises also here with the formation of queues that tends to require a long time in preparation for the training, since the method according to the said documents is still based on observation of the results of firing the simulator in a target system.

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### DESCRIPTION OF THE INVENTION

A device and a method for the simulation of firing by means of a weapon are described according to the aspect of the invention. This is carried out with a simulator, mounted on a weapon with a sight, with the simulator arranged to emit an electromagnetic simulator beam exiting along a simulator axis. Furthermore, the simulator is arranged to emit a visible alignment beam along an alignment axis, which forms a fixed and known angle with the aforementioned simulator axis.

The term "axis" is here used to describe the axis of symmetry of the directions of propagation of the respective beams.

The simulator contains a means of adjustment to collectively control both of the aforementioned axes, the simulator axis and the alignment axis, so that they maintain their fixed and known relative angular relationship during the adjustment.

5 The alignment beam is made visible in the weapon's sight by means of a reflection device.

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The alignment beam can generate a guide mark, which, when it is viewed in the weapon's sight, indicates the error in direction between the simulator axis and the sight. This makes it possible for the firer simply to align the sight with the simulator axis with the aid of the means of adjustment.

The invention is otherwise characterised by the particular properties specified in the claims.

An advantage of a simulator according to the aspect of the invention is that it becomes possible not only in association with an exercise initially to align the simulator and the weapon after the simulator has been attached to the weapon, but also to check at intervals during the progress of the exercise that the alignment is still correct. A simulator on a light weapon is usually so placed on the weapon that it is exposed to blows and knocks, not least during exercises in forest, in connection with getting into and out of vehicles and during training in built-up areas, whereby an alignment that has been carried out may easily be disturbed. The trainees are given the opportunity by the invention to check, and if necessary adjust, the alignment of the simulator with the weapon reasonably easily.

A further major advantage is that the alignment device is small, simple and cheap, and that it can, in principle, be carried by every soldier who uses a weapon of a type that can be equipped with a simulator according to the invention.

The alignment device can be an integral part of the simulator or it can be a part that is easily attached, and which requires a minimum of space. In this way, it should be possible for a soldier to carry the alignment device without inconvenience during an exercise.

## DESCRIPTION OF THE FIGURES

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Figure 1 shows a simulator on a weapon and specifies the sighting axis, the simulator axis and the alignment axis.

Figure 2 shows two images with alignment marks and the guide mark of the sight before (Figure 2a) and after (Figure 2b) adjustment.

Figure 3 illustrates an alternative appearance of the alignment mark.

Figure 4 shows the laser emitter and the alignment beam emitter.

Figure 5 shows an adjustment device for the collective adjustment of the directions of the simulator axis and the alignment axis.

Figure 6 shows how a reversing prism column returns the alignment beam.

Figure 7 shows a transparent prism column which makes it possible to see through the column from the sight.

Figure 8 shows the use of a collimator to return the alignment beam towards the sight.

Figure 9 shows a general version of the simulator with a fixed angle between the simulator axis and the alignment axis.

Figure 10 shows a means of reflection used to return the alignment beam to the sight, for a general version of the simulator.

## DESCRIPTION OF THE EMBODIMENTS

In the following, a number of embodiments according to the aspect of the invention will be described, supported by the figures. A simpler version is described in the first embodiment, in

which the simulator axis and the alignment axis are made to be parallel, that is, the fixed angle between the axes in this embodiment is zero degrees.

A simulator 1 is mounted onto a weapon 2 equipped with a sight 3. A simulator beam 4 is generated in the simulator 1 along a simulator axis 5. The simulator also emits an alignment beam 6 along an alignment axis 7, which is parallel to the simulator axis 5. The weapon's sight 3 defines a sighting axis 8, and it is this sighting axis that defines the direction in which a shot will leave the weapon 2 when firing with live ammunition.

The simulator axis 5 of the simulator is to be brought to be parallel with the sighting axis 8. It would be possible to allow the alignment beam 6 to hit a target and observe in the sight 3 an alignment mark 9 made by the alignment beam. This may be associated, however, with a number of practical difficulties, such as that it may be difficult to observe the alignment beam in a situation of high ambient light. Further, a parallax error arises since the axes 5, 8 are placed at a certain distance from each other, which must be compensated for.

If one instead places the target in the focal plane of a closed optical system (a collimator 10), the ambient light will be less of a problem. Such a collimator 10 must have a diameter that allows both the alignment axis 7 and the sighting axis 8 simultaneously to pass through the optical system of the collimator 10, as is shown in Figure 8.

In cases in which the sighting axis 8 and the alignment axis 7 are separated by a considerable amount, it may be easier to use a reversing prism 11 in order to guide the alignment beam 6 to the sight 3.

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A reversing prism has the property of returning incident light in exactly the opposite direction, with a parallel displacement that is determined by the design of the prism, as is shown in Figure 6.

If the prism itself 11 is placed, as a result of the placement of the simulator 1, within the sight 3 (for example between the bead and the rear sight) as shown in Figure 7, then it is an advantage if the prism 11 is provided with a semi-transparent section so that the prism does not block the sight.

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If the simulator is to function in a stable manner, it is an advantage if both the simulator beam 4 and the alignment beam 6 are generated by the same optical system. Here, a laser emitter 12 is used to generate the simulator beam, and this laser emitter 12 is placed in the focal plane of an optical system. In this case, it is an advantage to place a reticle 13, which generates the alignment beam 6, in the same focal plane as the laser 12 and to connect these, that is the laser and the reticle, with a fixed mechanical connection. This arrangement using a common optical system, represented here in the form of a lens 14, and a stable mutual anchoring of the laser and the reticle in the simulator provides a simple method of ensuring that the alignment axis and the simulator axis are parallel. See Figure 4.

The collective adjustment of these two axes, the alignment axis 7 and the simulator axis 5, becomes very simple in this case. Either the optical system can be suspended in mechanically adjustable gimbals, or optical redirection elements can be used, for example a pair or rotatable optical wedges 15, in order to achieve adjustment of the direction of the axis (Figure 5).

It is appropriate to create the alignment beam 6 by allowing a lamp or light-emitting diode to illuminate the reticle 13. Alternatively, ambient light can be guided onto the reticle.

- The alignment device is attached during the alignment procedure, so that the prism device on the simulator and any illumination of the reticle 13 that is required are activated. This means that a stable image of the reticle 13 the alignment mark 9 is obtained in the sight 3. See Figure 2a, in which the sighting mark 16 of the sight 3 is also shown.
- A means of adjustment (not shown) is linked to the adjustment device of the simulator with which the alignment axis (and thus also the simulator axis) can be influenced. Adjustment screws are usually used. The alignment mark 9 can now be moved by these adjustment screws within the sight 3 so that co-alignment of the alignment axis 7 (and thus the simulator axis 5) and the sighting axis 8 can be achieved. (Figure 2b).

In some cases only a part of the alignment reticle will be visible in the sight 3. The visible part must then indicate how the adjustment screws are to be turned in order to achieve coalignment. Several different embodiments of the alignment reticle 13 are possible. One further

example is shown in Figure 3. The alignment mark 9 can include arrows or other equivalent graphical symbols that clearly indicate the directions for turning the means of adjustment. In cases where it is only of interest to observe the alignment mark 9 in association with the adjustment, it can be an advantage to be able to remove from the simulator 1 those parts that are only required during the alignment. If a returning prism is used, it is natural to be able to remove this easily and store it separately. An alternative is that it may be folded into the simulator so that it is better protected.

In those cases in which the prism is removed, it is an advantage if the parts of the mechanical adjustment device can be removed that would otherwise be liable to damage when the simulator is used in the field.

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It is then appropriate that the removable units are built together to form a module. Electronic circuits associated with the alignment method can then be included in this module, for example, the circuits to activate illumination of the reticle and the circuits to define such simulator properties for the weapon as laser power, to define the range of the weapon, and code parameters, in those cases in which the simulator provides codes specific for the weapon during the simulation.

In those cases in which it is desired to check the alignment during operational use, it can be appropriate to have a semi-transparent prism column, and that only a part of the common light emitted from the optical system is directed to the prism column. In this case, the alignment mark 9 can be allowed to light up, for example, on each shot fired. It thus becomes visible in the sight 3 and can be used as an indication that the simulator simulates and that the alignment is correct.

It is also possible to use the actual simulator beam 4 as the alignment beam 6 by allowing the normally invisible simulator beam 4 to hit a wavelength converter which converts the simulator beam 4 to visible light. It can be particularly appropriate to use a wavelength converter as a projection screen in the collimator in cases in which a collimator is used to return the simulator beam, the wavelength converter then generates a visible mark that specifies the direction in which the simulator beam exits from the simulator.

A more general version of the simulator 1 according to the aspect of the invention is shown in Figure 9. The difference that characterises this version of the simulator in relationship to the one that has just been described is that the alignment axis 7 is allowed to deviate by a fixed angle  $\alpha$  from the simulator axis 5. If the said fixed angle  $\alpha$  is known, the reflection device 17 can be designed so that the alignment axis is parallel to the simulator axis 5 after passage through the reflection device, and can thus be used to align the simulator to the sight of the weapon. The fixed angle between the simulator axis and the alignment axis is maintained during the adjustment. Such an arrangement is shown in Figure 9, in which the simulator 1 is attached to a weapon 2. The simulator emits a simulator beam 4 in the form of a laser lobe, in the same way as described above, the axis of symmetry of which is used as the simulator axis 5, and a visible alignment beam 6 along the alignment axis 7, where the simulator axis and the alignment axis form a known angle  $\alpha$  to each other. A reflection device 17 is introduced during adjustment into the pathway of the simulator beam and the alignment beam in order to make the alignment beam visible in the sight. A general example of such a reflection device 17 includes three mirrors 18, 19 and 20, and is shown in Figure 9. The first mirror 18 and the second mirror 19 function as a roof prism and redirect at the same time the alignment beam 6 by an angle of essentially 90° in the vertical direction (in this example). A third mirror 20 is arranged at such a distance from the first two mirrors 18, 19 and at such a chosen angle to the first two mirrors 18, 19 that the alignment beam 6 is returned to the sight 3 with its alignment axis 7 parallel to the simulator axis 5 after compensation for the known angle  $\alpha$ . The alignment mark 9 can thus be observed in the sight, after which the alignment can be adjusted. Three mirrors with an angle exactly or close to 90° between them provide a function that does not critically depend on their mounting relative to the simulator. This is why the roof prism function is used. The mirrors can consist of polished and mirror-coated (or total reflecting) external surfaces of a glass prism, giving a stable construction.

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An alternative method for compensating for the angle  $\alpha$  is to use a reversing prism 21, which has mutual angles of exactly 90° between the three mirror surfaces, and in which the incident and reflected beams are parallel, together with an optical wedge 24, as shown in Figure 10. The function of the optical wedge is to compensate for the angle  $\alpha$ .

#### **CLAIMS**

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1. Simulator (1) constructed for the simulation of firing mounted onto a weapon (2) with a sight (3), in which the simulator (1) is equipped with a first device (12) that emits an electromagnetic simulator beam exiting along a simulator axis (5), characterised in that - the simulator (1) is also equipped with a second device (13) that generates an alignment beam along an alignment axis (7)

- the angle between the simulator axis (5) and the alignment axis (7) is fixed and known, and that
- the simulator (1) includes a means of adjustment that collectively guides the alignment axis (7) and the simulator axis (5) during the alignment of the simulator axis (5) with the sight (3) so that the said axes during the alignment maintain the fixed relative angular relationship.
- 15 2. Simulator according to claim 1, characterised in that the first device (12) consists of a laser emitter.
  - 3. Simulator according to claim 1, characterised in that the simulator (1) includes a wavelength converter that converts the alignment beam to visible light.
  - 4. Simulator according to claim 1 or 2 or 3, **characterised** in that a reflection device (17) that reflects the alignment beam (6) so that it becomes visible in the sight (3) of the weapon is arranged with the simulator (1).
- 5. Simulator according to claim 4, characterised in that the reflection device (17) consists of a first mirror (18) and a second mirror (19) that function as a roof prism and deflect the alignment beam (6) by 90° and a third mirror (20) placed at such a distance from the first and second mirrors and at such an angle relative to them that the alignment beam (6) is reflected into the sight (3) with the alignment axis (7) parallel to the simulator axis (5).

6. Simulator according to claim 5, **characterised** in that the reflection device (17) consists of a prism (21) with first reflecting surfaces (22) and a second reflecting surface (23) arranged at such an angle relative to each other that the alignment beam (6) is deflected back into the sight (3) with the alignment axis (7) parallel to the simulator axis (5).

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- 7. Simulator according to claim 4, **characterised** in that the reflection device consists of a reversing prism (21) dimensioned so that the alignment beam (6) is deflected back into the sight (3), and where an optical wedge (24) is arranged in the pathway of the alignment beam (6) by the reversing prism, whereby the optical wedge (24) refracts the alignment beam (6) so that the alignment axis (7) at the sight (3) becomes parallel with the simulator axis (5).
- 8. Simulator according to claim 6 or 7, characterised in that the prism (21) has a transparent part at least at the line of sight of the sight (3), whereby aiming can still be carried out even though the prism (21) is placed in or in front of the sight.
- 9. Simulator according to claim 1, characterised in that the fixed angle between the simulator axis (5) and the alignment axis (7) is zero degrees, that is, the said axes are mutually parallel.

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- 10. Simulator according to claim 9, characterised in that the first device (12) consists of a laser emitter.
- 11. Simulator according to claim 9, **characterised** in that the simulator (1) includes a wavelength converter that converts the alignment beam to visible light.
  - 12. Simulator according to claim 9 or 10 or 11, **characterised** in that the alignment beam and the simulator beam exit in the same direction and that to the simulator (1) is attached a reflection device (10, 11) that reflects the alignment beam in the opposite direction so that the alignment beam becomes visible in the sight of the weapon.
  - 13. Simulator according to claim 12, **characterised** in that the reflection device consists of a projection screen.

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- 14. Simulator according to claim 12, **characterised** in that the reflection device consists of a collimator (10).
- 5 15. Simulator according to claim 12, characterised in that the reflection device consists of a reversing prism column (11).
  - 16. Simulator according to claim 15, **characterised** in that the reversing prism column (11) has a transparent part at least in the line of sight of the sight (3), whereby aiming can be carried out despite the fact that the reversing prism column (11) is placed in or in front of the sight.

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- 17. Simulator according to claim 1, **characterised** in that the alignment beam (6) is generated by an illuminated reticle (13) in the focal plane of an optical system.
- 18. Simulator according to claim 17, **characterised** in that the reticle (13) is illuminated by means of an artificial light source.
- 19. Simulator according to claim 17, **characterised** in that the reticle (13) is illuminated with the aid of a means of guiding light that guides ambient light to the reticle.
  - 20. Simulator according to claim 1, **characterised** in that the alignment beam (6) and the simulator beam (4) have common focussing optical elements for their focussing.
- 21. Simulator according to claim 20, **characterised** in that the alignment beam (6) and the simulator beam (4) are generated by components that are mechanically attached to each other in the focal plane of the common optical system.
- Simulator according to claim 1, characterised in that those parts of the simulator (1)
   that are only required during adjustment are arranged in a demountable module.
  - 23. Simulator according to claim 22, **characterised** in that the demountable module includes at least one of the devices related to the alignment beam (6).

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24. Simulator according to claim 23, characterised in that the demountable module includes parts of the means of adjustment.

- 5 25. Simulator according to claim 23, **characterised** in that the demountable module includes a means for storing data that has been supplied to the simulator (1) in association with an alignment.
- Simulator according to claim 1 or 9, characterised in that the alignment mark (9) is
   designed with graphical symbols, such as arrows or equivalent pointers, so that it gives a graphical guidance in which direction the means of adjustment must be set when alignment is to be carried out.
- 27. Method of alignment of a simulator (1) mounted onto a weapon (2) with sight (3) characterised in that the method includes the following steps:

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- the simulator emits an electromagnetic simulator beam (4) that exits along a simulator axis (5),
- the simulator generates an alignment beam (6) along an alignment axis (7), which forms a fixed and known angle relative to the said simulator axis (5),
- the alignment axis (7) and the simulator axis (5) by means of a means of adjustment are collectively guided so that the said axes during an alignment or during an adjustment of the alignment maintain the said fixed relative angular relationship to each other and that
  - the alignment axis (7) is adjusted to be parallel with the sighting axis (8) of the sight (3).
- 28. Method according to claim 27, **characterised** in that a wavelength converter converts the alignment beam to visible light.
- Method according to claim 27, **characterised** in that the simulator beam is caused to be reflected form a wavelength converter material, whereby visible light is emitted and used as the alignment beam (6).

- 30. Method according to claim 27, characterised in that the alignment beam produces an alignment mark (9) that becomes visible to the firer when the sight (3) of the weapon (2) is used.
- Method according to claim 29, **characterised** in that the alignment mark (9) is made visible only in association with the conduct of an alignment or a check of the alignment.
  - 32. Method according to claim 29, **characterised** in that the alignment mark (9) is made visible in association with every shot fired by the weapon so that the firer obtains confirmation that a simulation shot has been fired and that the alignment is still correct.

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33. Method according to claim 27, **characterised** in that the alignment beam (6) and the simulator beam (4) are focussed by means of the same optical components.

1/4

Fig. 1

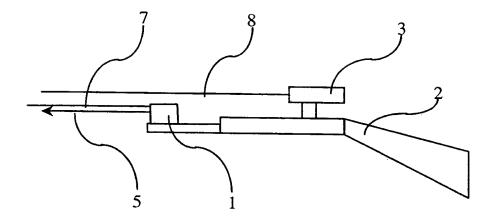


Fig. 2a

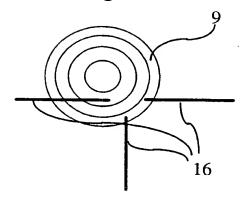


Fig. 2b

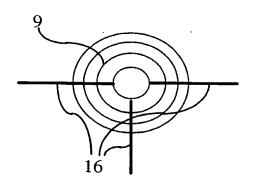
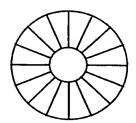


Fig. 3



2/4 Fig. 4

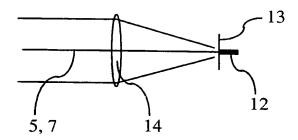


Fig. 5

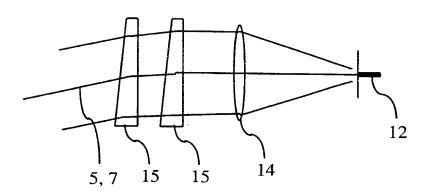


Fig. 6

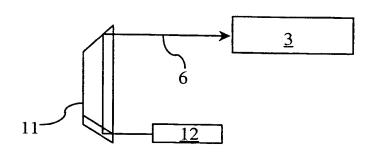


Fig. 7

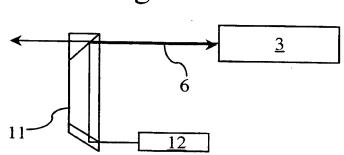
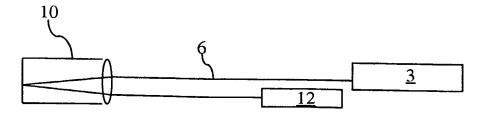


Fig. 8



4/4

Fig. 9

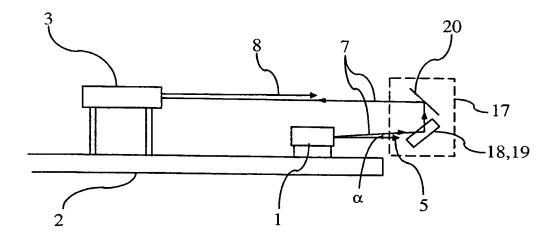
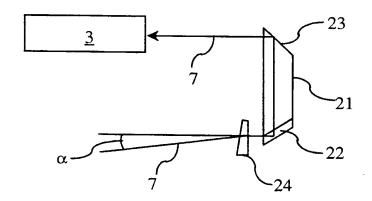


Fig. 10



## INTERNATIONAL SEARCH REPORT

International application No. PCT/SE 00/00442

### A. CLASSIFICATION OF SUBJECT MATTER

IPC7: F41A 33/02, F41G 1/54, F41G 3/32, F41G 3/26 According to International Patent Classification (IPC) or to both national classification and IPC

#### **B. FIELDS SEARCHED**

Minimum documentation searched (classification system followed by classification symbols)

Further documents are listed in the continuation of Box C.

IPC7: F41A, F41G

X

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

## SE,DK,FI,NO classes as above

Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)

C. DOCU	MENTS CONSIDERED TO BE RELEVANT	
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A	US 3792535 A (A.H. MARSHALL ET AL), 19 February 1974 (19.02.74)	

*	Special categories of cited documents:	<b>"T"</b>	later document published after the international Elian data			
"A"	document defining the general state of the art which is not considered to be of particular relevance		later document published after the international filing date or priori date and not in conflict with the application but cited to understand the principle or theory underlying the invention			
"E"	"L" document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified)  "O" document referring to an oral disclosure, use, exhibition or other means  "P" document published prior to the international filing date but later than the priority date claimed		document of particular relevance: the claimed invention cannot be			
"L"			considered novel or cannot be considered to involve an inventive step when the document is taken alone			
~0~			document of particular relevance: the claimed invention cannot be considered to involve an inventive step when the document is			
"P"			combined with one or more other such documents, such combination being obvious to a person skilled in the art			
			document member of the same patent family			
Date	Date of the actual completion of the international search		of mailing of the international search report			
			26 -06- 2000			
20 June 2000		20 00 1000				
Nam	Name and mailing address of the ISA		Authorized officer			
Swe	dish Patent Office					
Вох	Box 5055, S-102 42 STOCKHOLM Facsimile No. + 46 8 666 02 86		Christer Wendenius / MRo Telephone No. + 46 8 782 25 00			
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See patent family annex.

## INTERNATIONAL SEARCH REPORT

International application No. PCT/SE 00/00442

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